Cascade Sequencer Controller for AM Series Models:

Water Heaters:

- AM 399W
- AM 500W
- AM 750W
- AM 1000W

Boilers:

- AM 399B
- AM 500B
- AM 750B
- AM 1000B

NOTE: This manual, at Rev-B, is applicable to AM units of serial number **15000000 and above**. For units with prior serial numbers, consult the Rev-A release of this manual (GF-146-CS).

USER MANUAL

Installation and Operation

AERCO AM Series

Cascade Sequencer Controller

For AM Series Water Heaters or Boilers

Cascade Sequencer Controller Front Panel

Latest Update: 06/25/2015

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AERCO Document Conventions

Message Type	Example and Description
Notes	NOTE **NOTE** messages indicate specific information related to the surrounding contextual information, and highlighted for special attention.
Cautions	CAUTION! **CAUTION** messages inform of potential problems relating to the functioning of equipment, safety to persons, harm to the environment, and/or damage to property or equipment.
Warnings	WARNING! **WARNING** messages warn of potential dangerous situations that may result in serious injury and/or death to persons or animals. Text is red within a red box.
Instructions	How Instructions are Presented 1. Instructions are shown in a blue box with an underlined title. 2. All text, excepting in accompanying illustrations, is colored blue. 3. All procedures are listed in steps starting with "1." and using letters [a), b), c), etc.] indicating sub=steps. 4. Steps that are continued on the next page have a "**(Cont.)**" appended to the instruction title.

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INTRODUCTION

The AM Series Cascade Sequencer controller is used to control a cascade arrangement of up to eight (8) AM Series water heaters or boilers. This document provides instructions for installation and operation of the cascade sequencer.

Please note that the cascade sequencer requires a communications board be installed in each AM Series boiler or water heater. This board is present in every AM 500, 750, and 1000 but is an option on the AM 399 and must be installed prior to cascade sequencer installation. For further information see the AM Series Modbus installation Guide (TID-0123).

Cascade Sequencer Controller Front Panel

The AM Series Cascade sequencer Kit is comprised of:

- AM Series Cascade Sequencer unit
- AM Series Cascade Sequencer User Manual (OMM-0101)

WARNING!

Installer: Read the manual for the appliance(s), including this manual, before installing. Perform steps in the order given.

User: This manual is for use only by a qualified heating installer. Failure to comply with these provisions can lead to a dangerous situation and/or damage to property and equipment.

Installation and Alterations: Only a Qualified installer must carry out the installation and calibration of the appliance(s). Never modify the appliance or its flue gas carrying components in any way. This heater must be properly vented. Failure to follow these instructions could result in personal injury or death!

CHAPTER 1: INSTALLATION

1.1 Piping Installation

WARNING!

Prior to appliance installation and/or maintenance, disconnect the appliance's electrical power supply and shut off the inlet gas valve. Failure to follow these instructions could result in severe personal injury or death!

In order for the AM Cascade Sequencer to operate correctly, the AM Series heaters must be installed as shown in Figure 1-1.

Because the cascade general sensor is installed on the Manager heater, the managing heater must always be the closest to the low loss header in order to provide the most accurate temperature measurement.

A maximum of eight (8) heaters may be connected into the cascade system.

At the time of the installation all heaters will have the same settings. After installation, the heater nearest the low loss header will require some software adjustment to become the managing heater, and the other heaters will need a change to the software settings to become the dependent heaters. Instructions for doing this are provided in the following sections.

NOTE

Figure 1-1 shows only one piping configuration example. Other piping configurations are possible. Contact AERCO technical support for information concerning alternative configurations.

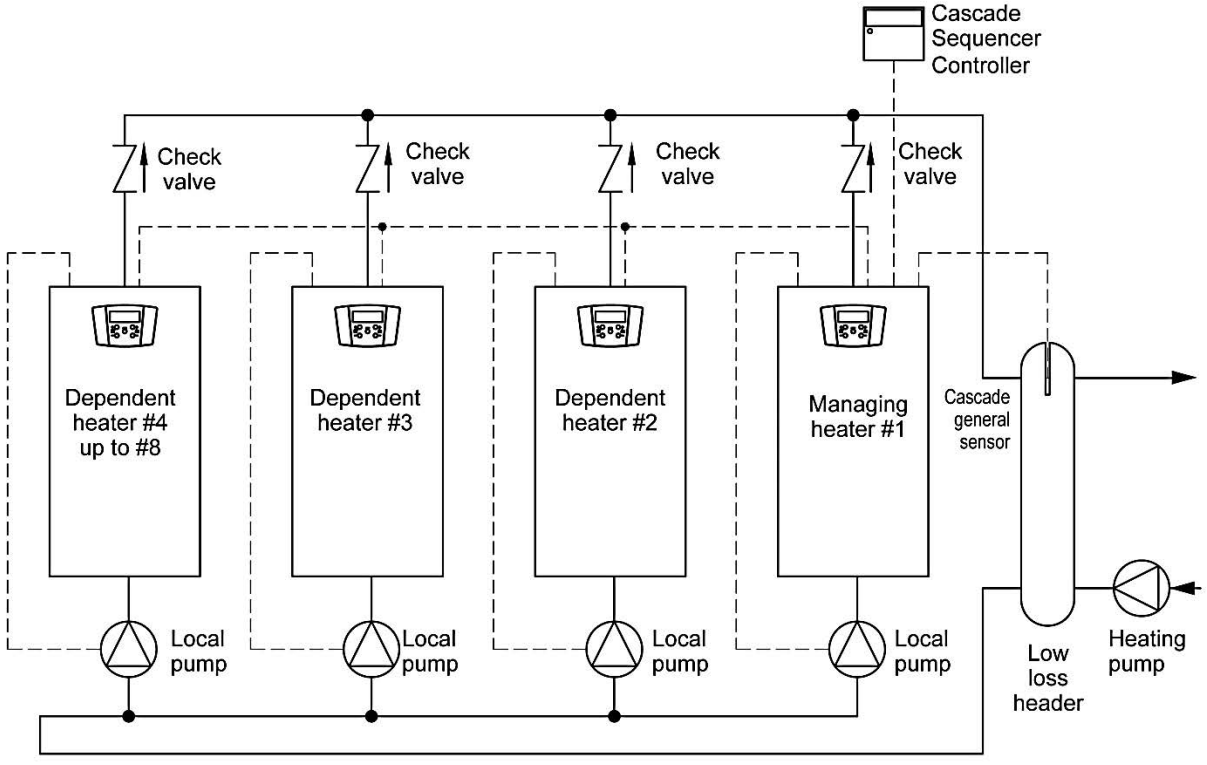

Figure 1-1: Cascade Sequencing Heater/Boiler Piping Installation

1.2 Electrical Installation

The electrical installation must be done as shown in Figure 1-2.

Installer must install all wires represented by dashed lines. The “Cascade general sensor” is present inside each heater’s accessory box. This sensor must be electrically wired to terminals 24 and 25 of the Managing heater # 1 and placed into the low loss header of the cascade (see Figure 1-1).

The "daisy chain" wiring used to connect boilers should be shielded type and has a maximum length of 300 ft. Unshielded wire is acceptable but not recommended, and the maximum length is only 60 ft.

Depending on the control method of your system, additional wiring may be required. For outdoor reset using the included outdoor temperature sensor, connect the outdoor temperature sensor to terminals 14 & 15 of the managing boiler. For remote setpoint (0-10V) control, connect the 0-10V signal wires to terminals 22 & 23 of the master boiler. For Modbus control of the operating setpoint connect to terminals 18, 19, and 20. For further information on Modbus, see GF-146-MB.

If there is a water heater tank present in the system, whether direct or indirect, the tank sensor should be placed in the bottom 1/3 of the tank and wired into terminals 12 & 13 of the managing heater. This sensor is included in the spare parts kit shipped with each unit, and is the same probe as the cascade header temperature sensor.

For further information on all of these control modes, consult the AM Series Boiler and Water Heater User Manual (GF-146).

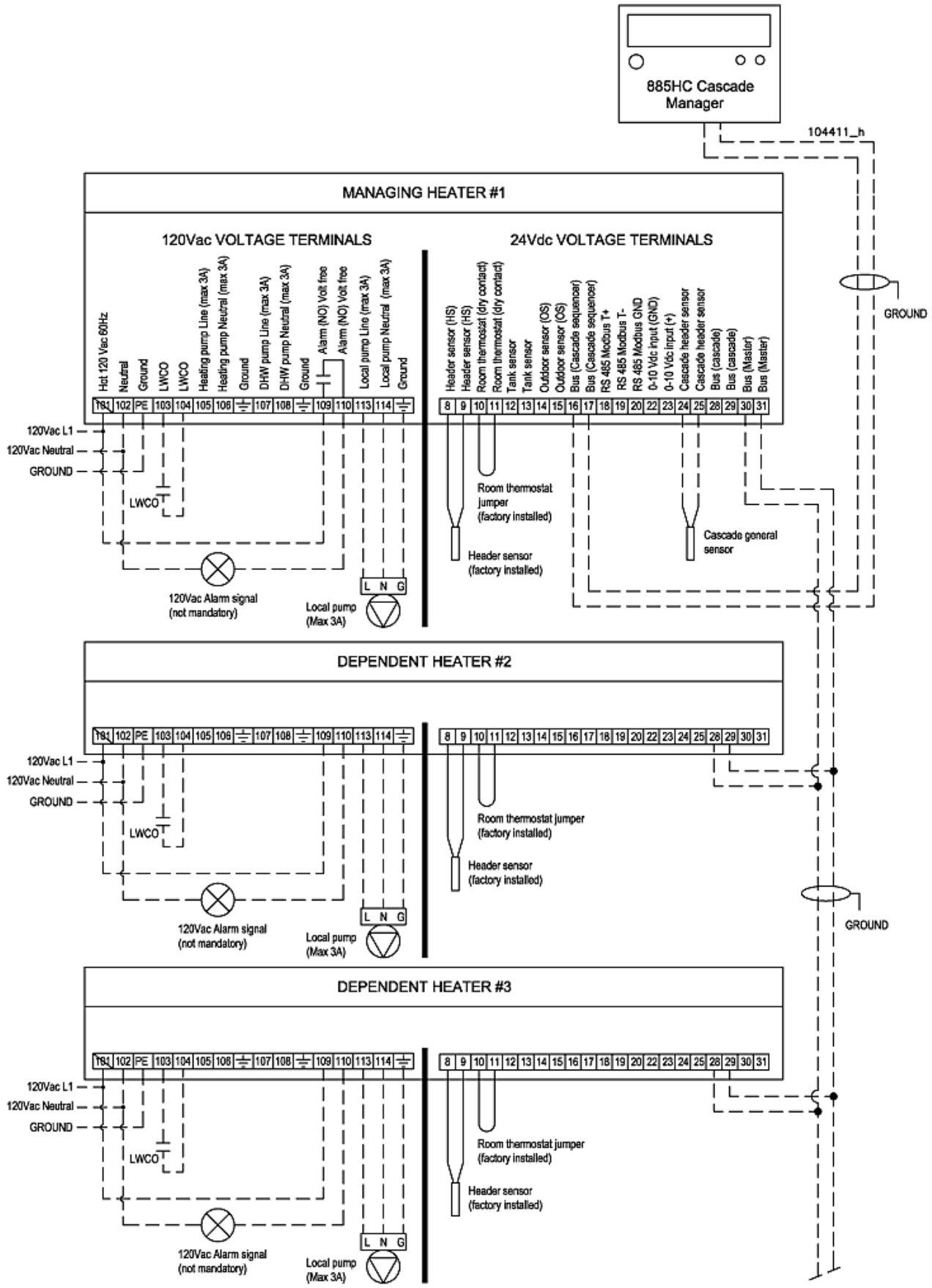

Figure 1-2: Cascade Sequencing System Electrical Wiring

1.3 Manager Heater Preparation

> **NOTE**
>
> Ensure that the heater being prepared as the managing heater is the one installed closest to the low loss header.

1.3.1 Setting Manager Heater S4 Switch to ON

To electrically prepare an AM Series heater/boiler for use as the Managing appliance for the Cascade Sequencer, the S4 switch on the communications board must be set to ON as described below.

Setting Manager Heater S4 Switch to ON

1. Gain access to the inside of the electrical junction box by removing the unit top cover and the electrical junction box top cover (see Figure 1-3).

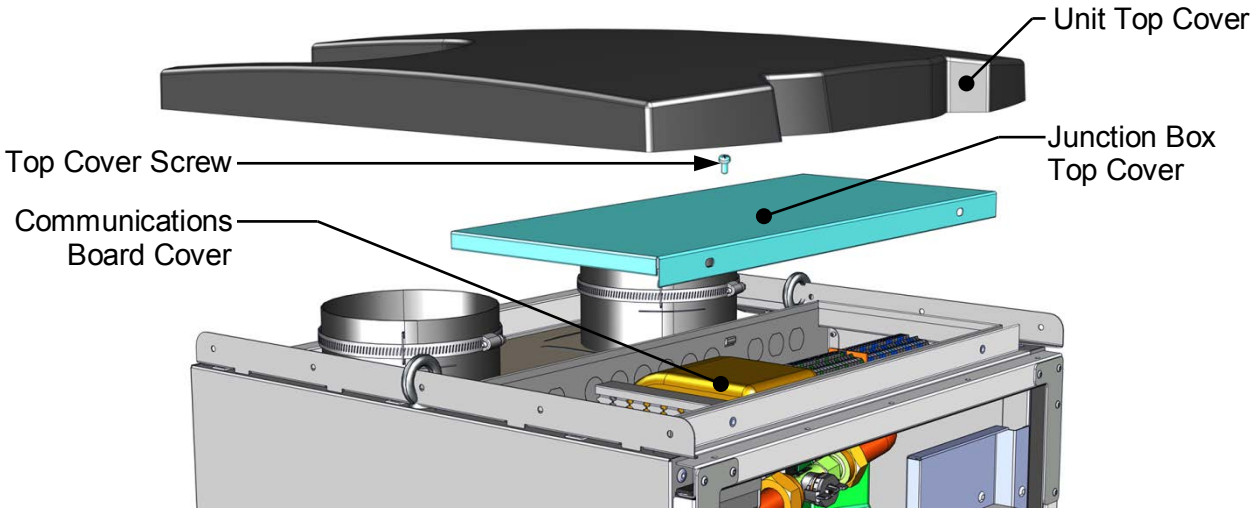

Figure 1-3: Accessing the Junction Box of the Managing Heater

2. Locate the communication board cover inside the junction box (see Figure 1-4).

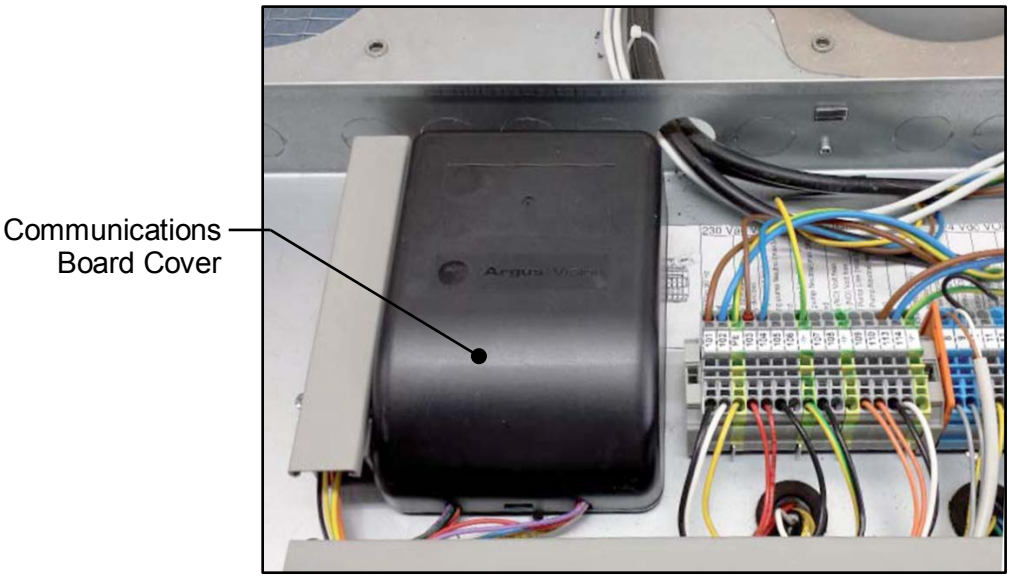

Figure 1-4: Locating the Communications Board inside Electrical Junction Box

Setting Manager Heater S4 Switch to ON – **Continued**

3. Using a flat head screwdriver, open the communications board cover (see Figure 1-5).

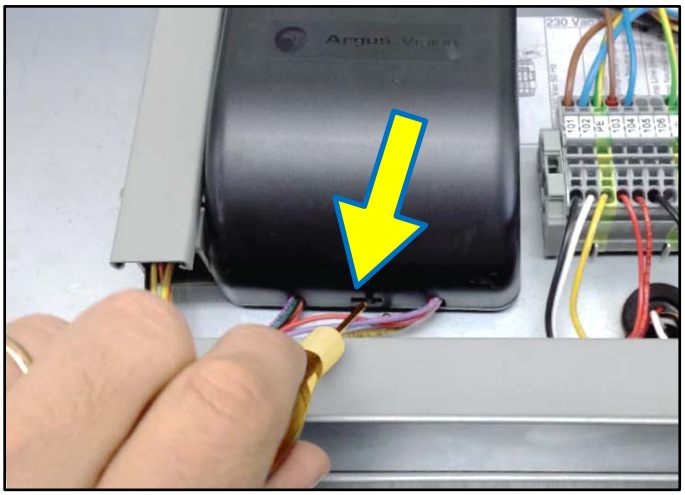

Figure 1-5: Removing Communications Board Cover

4. Locate S4 switch at front edge of communications board per Figure 1-6.
5. Set S4 switch to ON (LEFT as you are facing the unit).

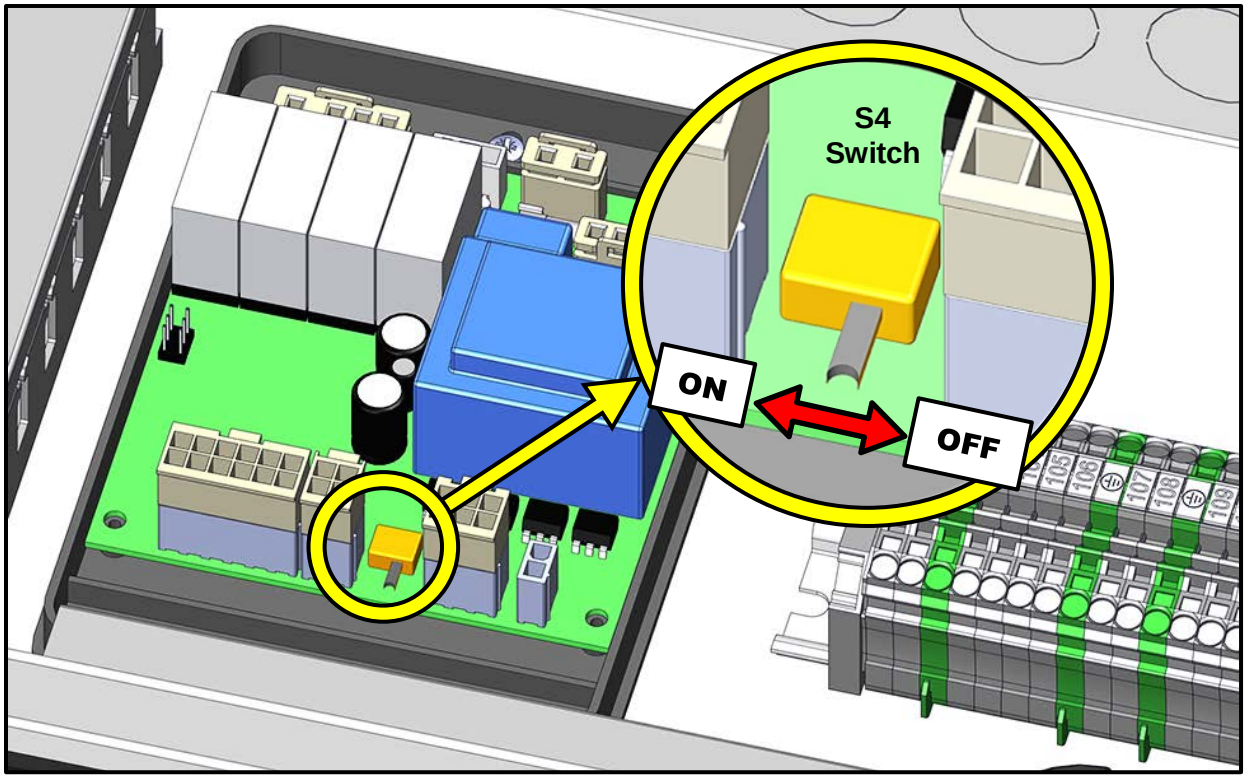

Figure 1-6: Setting Managing Heater Communications Board S4 Switch

NOTE

Wiring is not shown for image clarity.

1.4 Preparing the Cascade Sequencer for Use

The Cascade Sequencer is used to program the logic address of each heater, as well as control the final cascade system, and must be wired as described below.

Preparing the Cascade Sequencer for Use

1. Using a small flat head screwdriver, remove the rear cover of the Cascade Sequencer by levering up the panel via the slot, as shown in Figure 1-7.

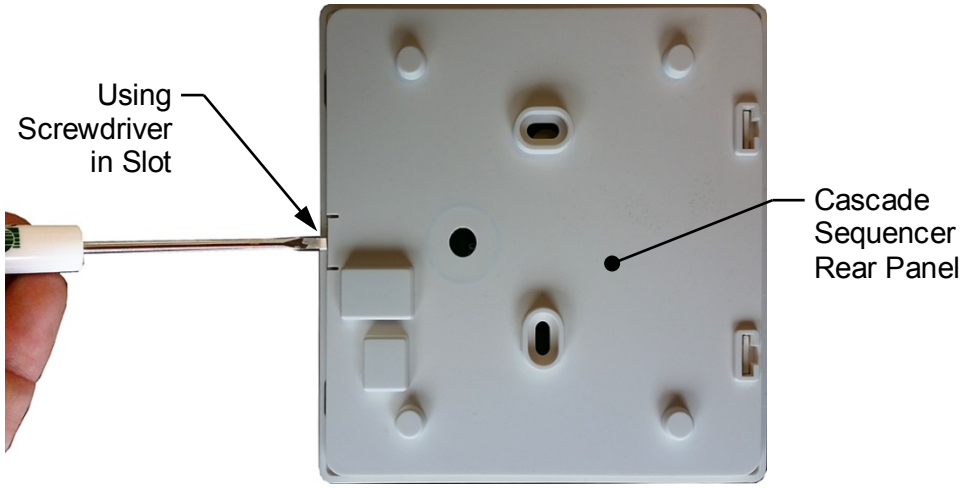

Figure 1-7: Opening Rear Panel of Cascade Sequencer

2. Connect two wires, each two feet (0.5m) long, to the two screw terminals on the Cascade Sequencer PCB, as shown in Figure 1-8. Wires do not have polarity.

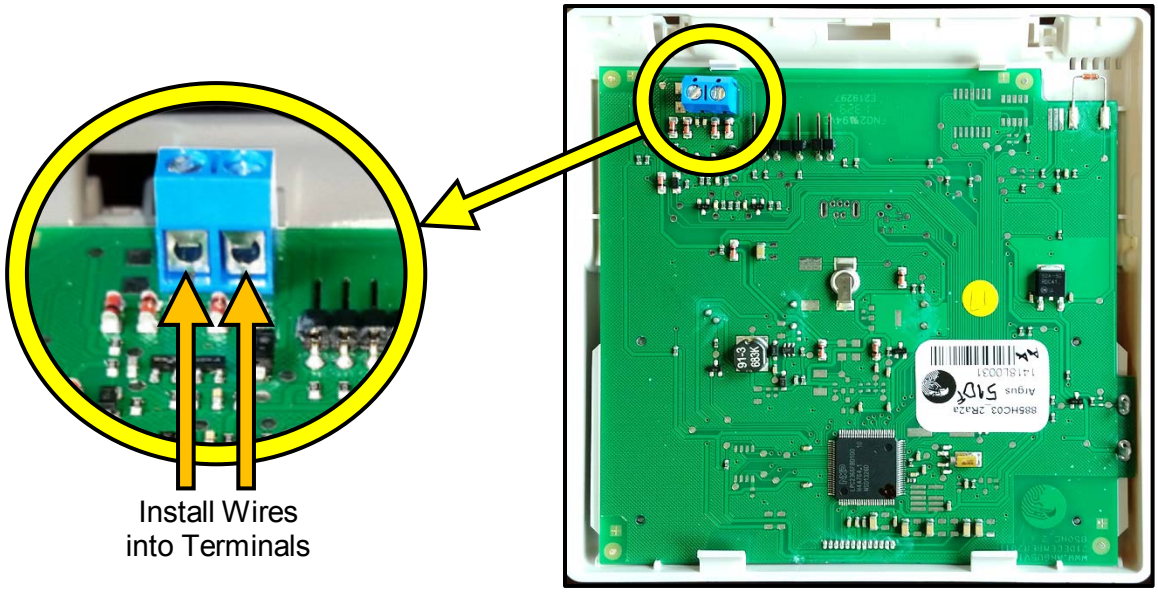

Figure 1-8: Connecting Wires to the Cascade Sequencer Terminals

Preparing the Cascade Sequencer for Use - **Continued**

3. Feed both wires through the rear panel conduit opening and snap rear panel onto rear of cascade Sequencer (Figure 1-9).

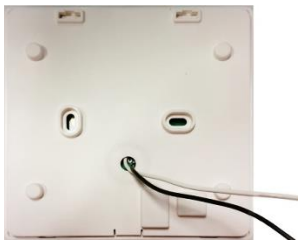

Figure 1-9: Replacing Rear Panel after Wiring

1.5 Setting the Logic Address for Each Heater

Program the logic address of each heater using the Cascade Sequencer as described below.

Setting the Logic Address for Each Heater

NOTE

Refer to Section 1.31 for location of the electrical junction enclosure and wiring terminals mentioned below. See Section 2 for how to operate the unit and access menus and parameters.

1. Ensure power is turned OFF to the Managing heater #1.
2. Connect the two wires from the Cascade Sequencer to terminals 16 and 17 of the Managing heater # as shown in Figure 1-10.

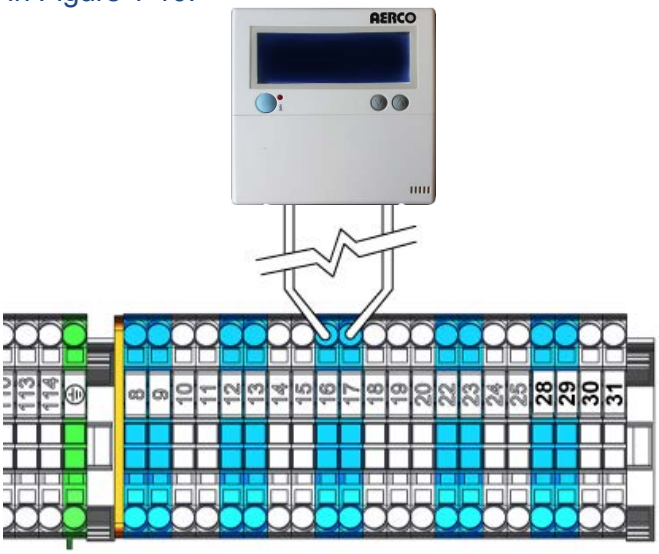

Figure 1-10: Wiring to Terminals 16 and 17 on AM Unit

NOTE

The wiring diagram shown in Figure 1-10 applies to all heaters in cascade, as each will be programmed with a unique logic address using the Cascade Sequencer. Other wiring is not shown for clarity.

Setting the Logic Address for Each Heater - Continued

3. Turn the power ON to the Managing heater #1. The Cascade Sequencer will also power up.
4. Wait until the Cascade Sequencer recognizes the boiler and "E2Prom Err" is not displayed.
5. Using the Cascade Sequencer, set the Address to 1 as follows:

Logic Address Programming Procedure

a) Press and hold the **Home button** (see Figure 2-1 in Chapter 2) for eight (8) seconds, then release the button to display the Sub menu.

b) Once the Sub menu is displayed (Figure 1-11), use the **Up** or **Down buttons** (Figure 2-1) to scroll through the list of parameters. A dot appears to the left of the parameter to indicate it is selected (Figure 1-11).

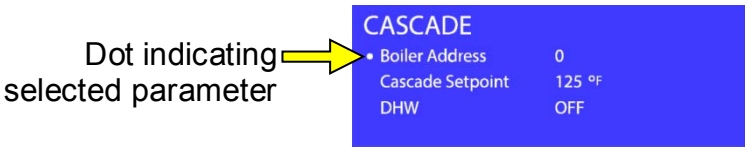

Figure 1-11: Sub Menu - Selecting the Parameter to Change

c) When the Boiler Address parameter is selected, press the **Ok button**. The dot will then move to the left of the parameter setting (Figure 1-12), which begins to blink, indicating it may be adjusted.

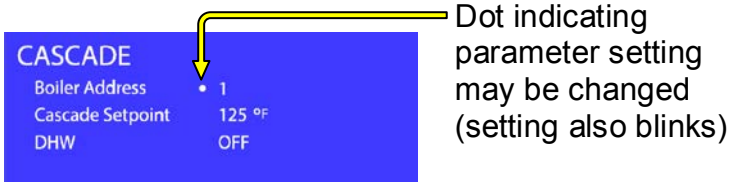
CASCADE
Boiler Address • 1
Cascade Setpoint 125 °F
DHW OFF
Dot indicating parameter setting may be changed (setting also blinks)

Figure 1-12: Sub Menu – Changing the Parameter Setting

d) Use the **Up** or **Down buttons** to change the parameter value up or down. For the Managing heater, set this to 1. For each Dependent heater, a different address is set, from 2 to 7, depending on how many dependent heaters in the cascade.

e) When the desired logic address number is displayed, save it by pressing the **Ok button**. To reject the change, do not press OK, and instead skip to the next step.

f) To return to the Main menu, press the **Menu button** (Figure 2-1).

g) Wait a minimum of 40 seconds or until "#1" appears in the upper left of the center box of the sequencer display.

IMPORTANT NOTE!

After any change to a parameter, wait at least 40 seconds before exiting the sub menu or turning the power off.

6. Turn the power off to the Managing heater #1.
7. Disconnect the two wires from terminals 16 and 17 of the Managing heater #1
8. Connect the two wires from the Cascade Sequencer to terminals 16 and 17 of the Dependent heater #2.
9. On the communications board at top of unit, set the S4 Switch (see Figure 1-6) to ON.
10. Turn the power ON to the Dependent heater #2.

Setting the Logic Address for Each Heater **- Continued**

11. Repeat steps a) through g) in Step 5 setting the logic address to 2.
12. Turn the power OFF to the Dependent heater #2.
13. Disconnect the two wires from terminals 16 and 17 of the Dependent heater #2.
14. Repeat steps 1 to 12 on each dependent heater and set the Address sequentially for each one (2, 3, 4, 5, etc.).
15. After all dependent heaters have had the logic address set, wire the Cascade Sequencer to terminals 16 and 17 of the Managing heater #1. The Cascade Sequencer is now set up for cascade operation. Ensure all switch settings match Figure 1-13.

1.6 Setting for Use with Boilers or Water Heaters

The Cascade Sequencer is set at the factory for boiler applications, but not for water heater applications. When your system is in place, and you wish to control water heaters, you must ensure all parameters of the Sub Menu are set as shown in the list in Section 2.1. Select the settings in the column for boilers if you are using boilers, or select the settings in the column for water heaters if you are using water heaters.

1.7 Dependent Heater Preparation – Setting Parameter 2003

Parameter 2003 is factory set to 0. However, this parameter should be checked for all dependent heaters to ensure parameter 2003 is set to 0.

Follow the instructions in Section 1.7.1 (next page) to access the Installer Menu on the AM Series boiler or water heater controller to confirm or change parameter 2003 to zero for all dependent heaters. If you need more information concerning AM Series controller operation, consult the AERCO AM Series user manual (GF-146), and at Rev-D for all AM Series units of serial number 15000000 and above.

1.7.1 AM Series Controller - Installer Menu Navigation

This menu of parameters is available to qualified technicians for the purpose of analyzing the function of, and making adjustments to, the unit.

Parameters for "Burner 1" are applicable for that burner only.

To enter and make changes in the Installer Menu, perform the following steps:

AM Series Controller - Installer Menu Navigation and Adjustment

1. To enter the Installer Menu, press and simultaneously hold down both the **RESET** and buttons or 5 seconds until the icon is displayed., then release the buttons. After entering the Installer Menu, the 2000 series of parameters are available for display and editing.
2. To scroll through the list of parameters, press buttons and .
3. Once parameter 2003 is displayed, it can be selected for editing by pressing the **RESET** button once (the displayed value will start blinking) and then using the and buttons to change the value, up or down. For dependent eaters, select 0.
4. To confirm the new value, press and release the **RESET** button.
5. To exit the Installer Menu, press and hold RESET button for more than 5 seconds until the icon is no longer shown in the display.

NOTE

This instruction is only for setting parameter 2003. For information about other parameters in the Installer Menu, refer to the AM Series user manual (GF-146), Rev-D.

1.8 Review of All Parameters

Figure 1-13 diagrams a cascade setup using three (3) AM1000 units (with four burner boards in each unit).

At the end of the installation process, all parameters (Address; Switch S4; 2003; 3001 and 3050) should have the values as shown on Figure 1-13.

If an attempt is made to operate the cascade system and the applicable parameters are not set to the values shown in Figure 1-13, one or more of the heaters in the cascade will display a 116 error (communication error) and will stop functioning.

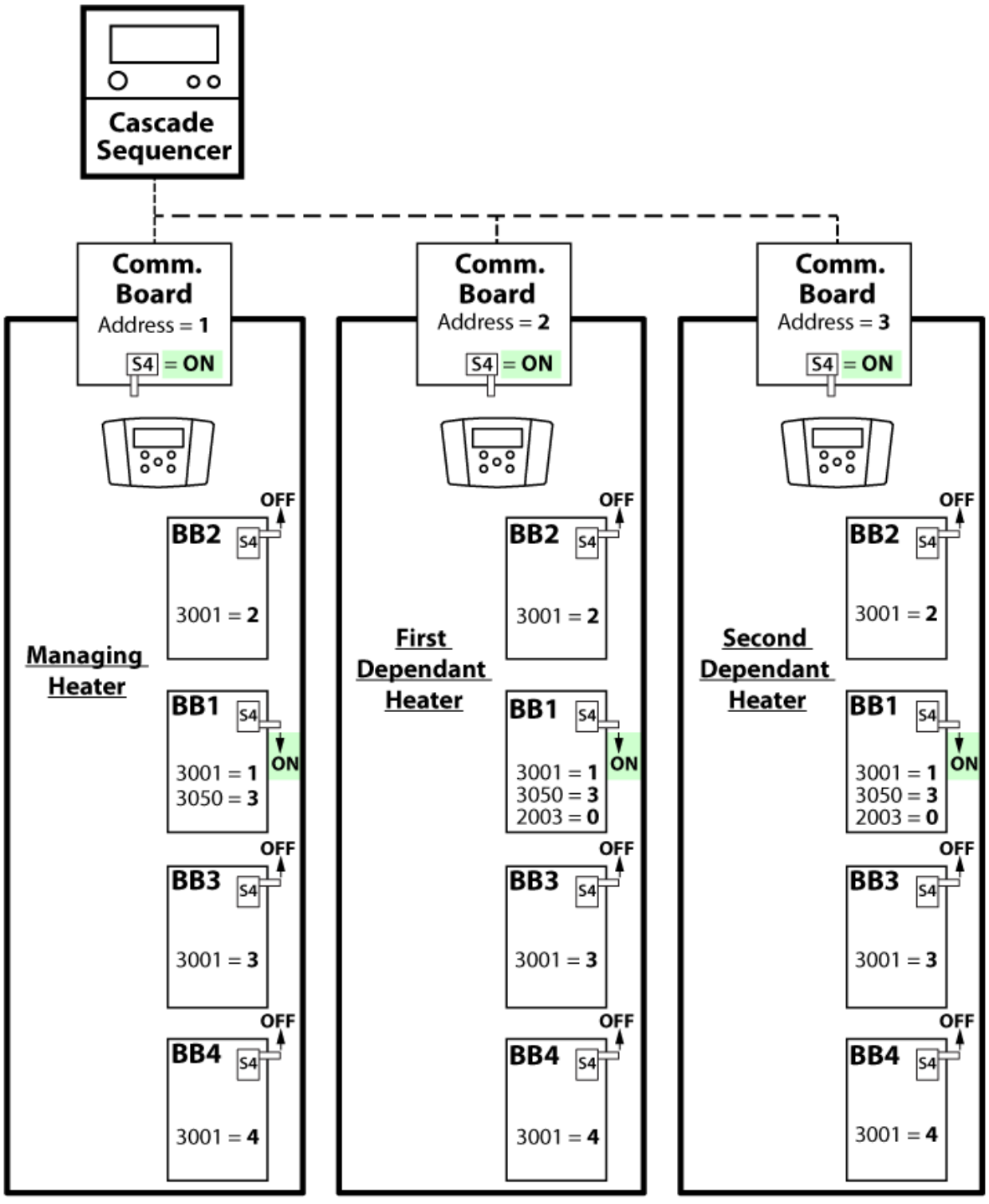

Figure 1-13: Cascade General Configuration and Settings Diagram

CHAPTER 2: OPERATION

> **NOTE**
>
> After turning on power, wait at least 40 seconds for communication between sequencer and heaters to finish before performing any operations. Wait for the cascade manager to recognize the address of the master boiler or water heater.

2.1 Cascade Sequencer Display and Controls

The AM Series Cascade Sequencer features a display and lower cover that is opened to reveal a number of buttons, as shown in Figure 2-1.

The icons labeled "M" and "D" represent the firing rate and current state of the first and second burners on the master unit and are not important to the function of the cascade manager.

If the outdoor temperature sensor is not connected it will display a temperature of "-40". Similarly, if the cascade temperature sensor is not connected it will display a temperature of roughly 12 to 14 degrees.

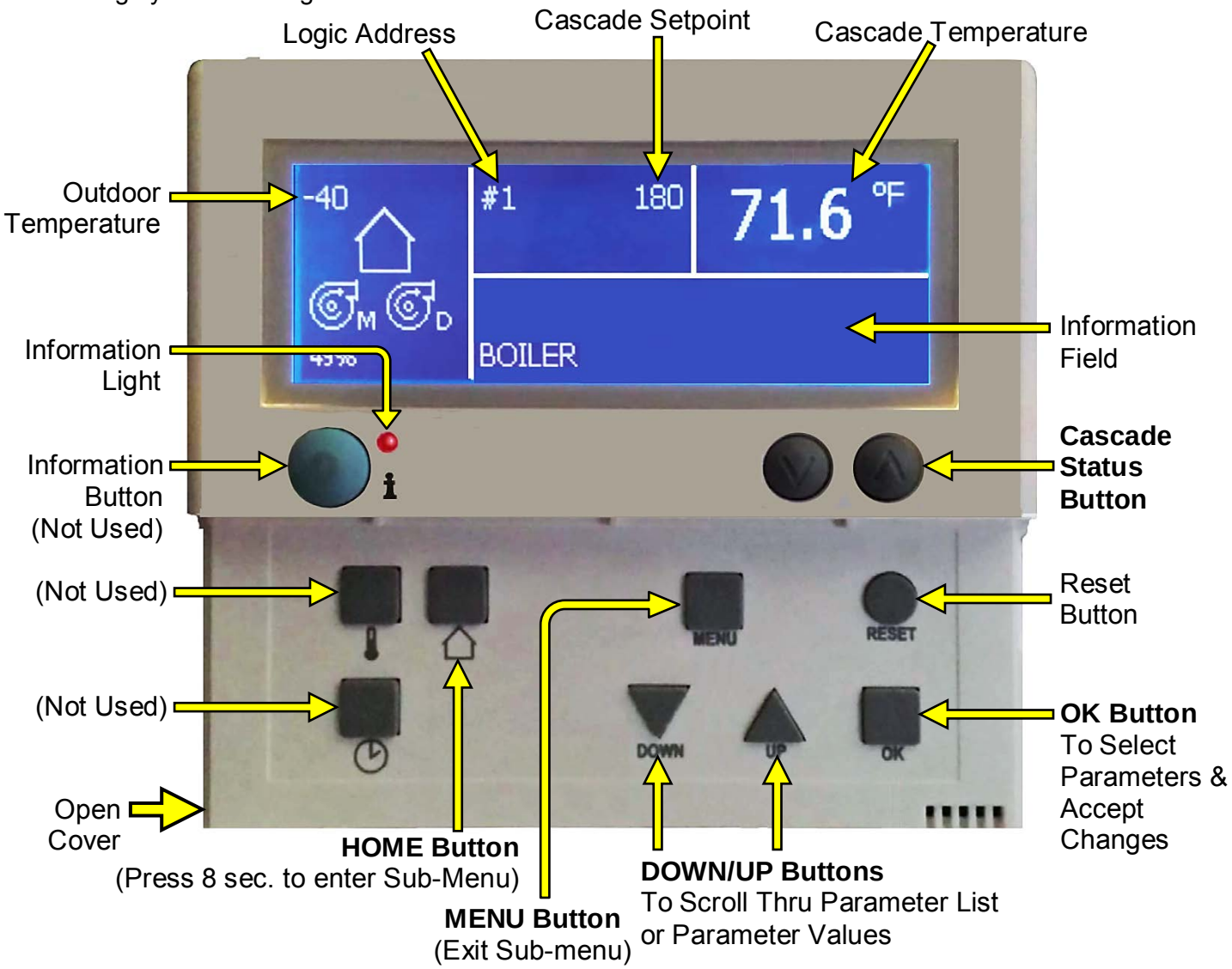

Figure 2-1: Cascade Sequencer Front Panel Features (Lower Cover Open)

2.2 Cascade Status Button

By pressing the Cascade Status button (Figure 2-1), the lower half of the display will change to show the status of the cascade boilers (Figure 2-2). The designated number for each boiler in the cascade system will be displayed, such as 1, 2, 3, 4, etc., up to 8. If there is a request for heating for any heater, a flame icon will appear under that heater's number. The absence of a flame icon under the number represents a heater in standby mode.

The Cascade Status display shown in Figure 2-2 indicates there are three heaters in the cascade, with numbers 1 and 2 calling for heat, and number 3 in standby mode.

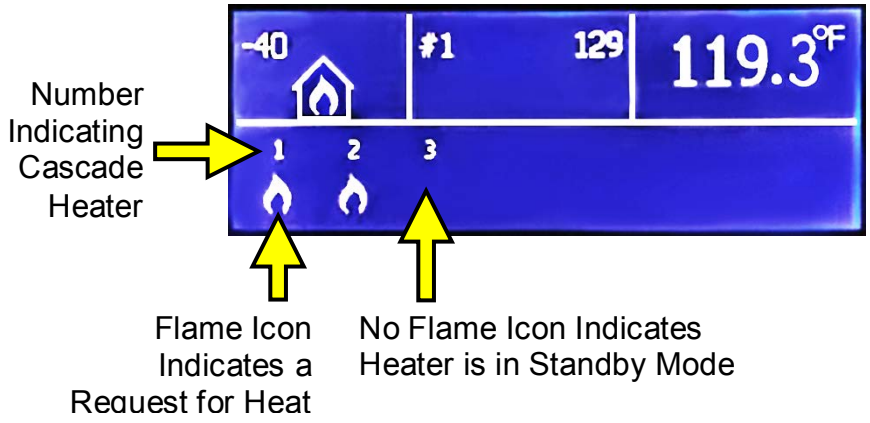

Figure 2-2: Cascade Status Display (When Cascade Button Pressed)

2.3 Submenu Navigation, and Parameter Settings

The sub-menu may be accessed, navigated, and parameters changed as instructed below.

Submenu Navigation and Parameter Settings

1. Press and hold the **Home button** (Figure 2-1) for eight (8) seconds, then release the button to display the Sub menu.
2. Once the Sub menu is displayed (Figure 2-3), use the **Up** or **Down buttons** (Figure 2-1) to scroll through the list of parameters. A dot appears to the left of the parameter to indicate it is selected.

Figure 2-3: Sub Menu - Selecting the Parameter to Change

3. When the desired parameter is displayed, press the **Ok button**. The dot will then move to the left of the parameter setting (Figure 2-4), which begins to blink, indicating it may be adjusted.

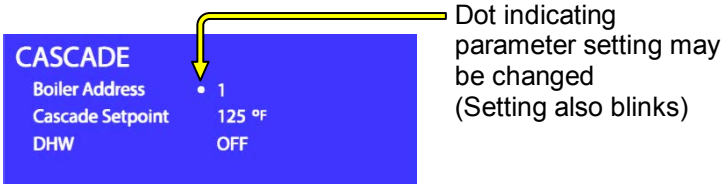
CASCADE
Boiler Address • 1
Cascade Setpoint 125 °F
DHW OFF
Dot indicating parameter setting may be changed (Setting also blinks)

Figure 2-4: Sub Menu – Changing the Parameter Setting

Submenu Navigation and Parameter Settings **– Continued**

4. Use the **Up** or **Down buttons** to change the parameter value up or down.
5. When the desired value is displayed, save it by pressing the **Ok button**. To reject the change, do not press OK, and instead skip to the next step.
6. To leave the Sub Menu and return to the Main menu, press the **Menu button** (Figure 2-1).

IMPORTANT NOTE!

After any change to a parameter, wait at least 40 seconds before exiting the sub menu or turning the power off.

2.4 Sub-Menu Parameter Descriptions

Below is a list of Menu parameters and descriptions. The table in the next section lists the range and default settings for each parameter.

Cascade Sequencer Parameter Descriptions

PARAMETER	DESCRIPTION
Boiler address	Logic boiler address
Cascade setpoint	Cascade general sensor setpoint
DHW ON..OFF	Enable / disable control for an indirect water heater
Start delay time	Delay for a call of the next boiler
Stop delay time	Delay to remove the call to the next boiler
Start boiler diff	Temperature differential to call the next boiler
Stop boiler diff	Temperature differential to remove the call to the next boiler
Stop all boiler diff	Temperature differential to remove the call to all boilers
Max offset up	Maximum difference *above* the header setpoint that any one boiler is allowed to reach.
Max offset down	Maximum difference *below* the header setpoint that any one boiler is allowed to reach.
Rotation interval	How often the “lead” boiler is rotated.
P Value	Proportional band of the PID temperature control of the cascade general sensor
I Value	Integral band of the PID temperature control of the cascade general sensor
D Value	Derivative band of the PID temperature control of the cascade general sensor
Slew rate	Slew rate is a low level parameter. It determines how fast the output of a PID can change per amount of time.
System correction	The system correction value is added to the measured system temperature. This corrected value is used for control. If the measured sensor value deviates from the real temperature then you can correct it with this parameter.
Mod delay factor	Delay to the start of modulation of any boiler.

2.5 Sub-menu Parameter Range and Default settings

Below is a list of the menu parameters with range and default settings. There is a table in the previous section that provides a description of each parameter.

Cascade Sequencer Sub-Menu Parameter List						
PARAMETER	UNITS	RANGE	FACTORY	BOILER SETTINGS	WATER HEATER SETTINGS	CUSTOM
Boiler address	/	0 …..16	0	0 - Stand Alone heater 1 – Managing Heater 2 – 1st Dependent Heater 3 – 2nd Dependent Heater 4 – 3rd……etc	0 - Stand Alone heater 1 – Managing Heater 2 – 1st Dependent Heater 3 – 2nd Dependent Heater 4 – 3rd……etc	
Cascade setpoint	°F	68..194	140	140	140	
DHW ON..OFF	/	ON..OFF	OFF	ON (only if you want to drive an indirect water heater)	OFF	
Start delay time	sec	0..1200	180	180	15	
Stop delay time	sec	0..1200	180	180	15	
Start boiler diff	°F	14..36	14	14	14	
Stop boiler diff	°F	14..59	14	14	14	
Stop all boiler diff	°F	14..59	26	26	26	
Max offset up	°F	14..50	24	24	24	
Max offset down	°F	14..50	37	37	37	
Rotation interval	Days	1..10	5	5	5	
P Value	/	0..255	20	20	20	
I Value	/	0..255	80	80	80	
D Value	/	0..255	0	0	0	
Slew rate	/	1..255	5	5	5	
System correction	°F	14..32	22.1	22.1	22.1	
Mod delay factor	min	0..60	4	4	0	

2.6 Troubleshooting Guide

Below is a list of possible issues and corrective actions.

Cascade Sequencer Troubleshooting Guide	
ISSUE	**CORRECTIVE ACTION**
Cannot set the unit address when installing cascade sequencer **OR** When trying to set the unit address, the new address does not appear on the cascade sequencer.	• Double check all wiring. • Ensure settings and switches are correct as per Figure 1-18.
Cascade system does not seem to be communicating correctly.	• Double check all wiring. • Ensure settings and switches are correct as per Figure 1-18. • Make sure that all units show up under the Cascade Status menu.
When trying to set the unit address, "#5" appears on all units.	This may indicate incorrect software in the communications module. Contact AERCO technical support for further information.
Domestic water heating tank is not reacting quickly.	Check that the parameters are all set according to the "Water Heater Settings".
System loop is not reaching desired setpoint.	• Check the location of the cascade header temperature sensor. Ensure that the sensor is located such that it will see flow from both the primary and secondary loops. • Check parameters 1120-1123 on each unit. Ensure that all modules are running at maximum capacity. If not, wait 10 minutes for burners to modulate up and check again. • Change System Correction factor from 14 to 22.1. • Check each unit's outlet temperature on the individual boiler or water heater interface. If Cascade Setpoint + Max Offset Up is less than or equal to any individual unit's outlet temperature, increase the Max Offset Up parameter.
Outdoor air temperature sensor on cascade sequencer shows "-40".	• Check that the sensor is wired to terminals 14 & 15 of the master boiler. • Make sure all electrical connections are tight. • Check sensor resistivity.
Cascade sequencer header temperature displays a low value (10-16°F).	Check that the cascade header temperature sensor is installed in terminals 24 & 25 of the master boiler or water heater.

NOTES:

Change Log:

Date	Description	Changed By
11/25/2014	Rev-A: Released	Curtis Harvey
06/25/2015	**Rev-B**: Changed AM electrical and wiring images per change of terminals 26-30 to 28-31 cascade wiring, updated various design elements, removed instructions and misc. revisions per changes to software.	Curtis Harvey

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